

Unit configuration

The following functionalities are selected by software service change entries at the system terminal and by jumper strap settings on the card:

- trunk type for each unit on the card
- termination impedance
- balance impedance
- incoming or incoming and outgoing call direction
- tone frequencies
- cadence
- tone levels

Jumper strap settings

For most applications, the jumper strap settings remain set to the standard configuration as shipped from the factory as described in Table 3.

For CO/FEX/WATS or TIE trunk loops exceeding 762 meters (2500 ft), DID trunks exceeding a loop resistance of 600 ohms, or RAN trunks operating in pulse start or level start modes, the jumper strap settings must be changed as shown in Table 4. Figure 4 shows jumper locations on the DXUT card.

In the rare case where loaded cable is used in the facility, 3CM2 balance termination is recommended. Software setup in Overlay 14 is also required.

Note: Refer to *Circuit card installation and testing* for further information regarding jumper strap settings.

Service change entries

Trunk type, terminating impedance, and balance network are selected by service change entries in the Trunk Administration program (Overlay 14). Refer to Table 5 to select the proper values for the trunk type and loop length being employed. Refer to the Meridian 1 *X11 input/output guide* for Overlay 14 service change instructions.

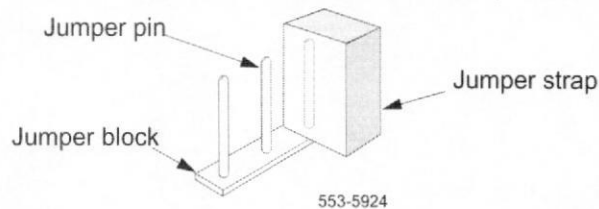
Before the appropriate balance network can be selected, the loop length between the near end (Meridian 1) and the far end (a Central Office, for example) must be known. To assist in determining loop length, some typical resistance and loss values for the most common cable lengths are given in Table 6 for comparison with values obtained from actual measurements.

Cadence, tone frequencies, and tone levels are selected by service change entries in Overlay 97.

Table 3
Jumper strap settings – factory standard (NT5D31AA)

Trunk types	Loop length	Jumper strap settings			
		J1.X	J2.X	J3.X	J4.X
CO/FEX/WATS	Zero – 1524 m (5000 ft)	Off	Off	1-2	Off
2-way TIE (LDR)					
2-way TIE (OAID)					
DID	Zero – 600 ohms				
RAN: continuous operation mode					
Paging					

Note 1: Jumper strap settings J1.X, J2.X, J3.X, and J4.X apply to all eight units; "X" indicates the unit number, 0–7. "Off" indicates that no jumper strap is installed on a jumper block. Store unused straps on the DXUT card by installing them on a single jumper pin as shown below:



Note 2: Jumper blocks labelled P1,P2, P28-P34 are used for testing and future options only and all straps associated with the "P" labelled jumper blocks are open at all times.

Table 4
Jumper strap settings – extended range (NT5D31AA)

Trunk types	Loop length	Jumper strap settings			
		J1.X	J2.X	J3.X	J4.X
CO/FEX/WATS	> 1524 m (5000 ft)	Off	Off	1-2	Off
2-way TIE (LDR)					
2-way TIE (OAID)					
DID	> 600 ohms	On	On	1-2	Off
RAN: pulse start or level start modes		Off	Off	2-3	Off
Note 1: Jumper strap settings J1.X, J2.X, J3.X, and J4.X apply to all eight units; "X" indicates the unit number, 0–7. "Off" indicates that no jumper strap is installed on a jumper block. Note 2: Jumper blocks labelled P1,P2, P28-P34 are used for testing and future options only and all straps associated with the "P" labelled jumper blocks are open at all times.					

Figure 4
Jumper locations (NT5D31AA)

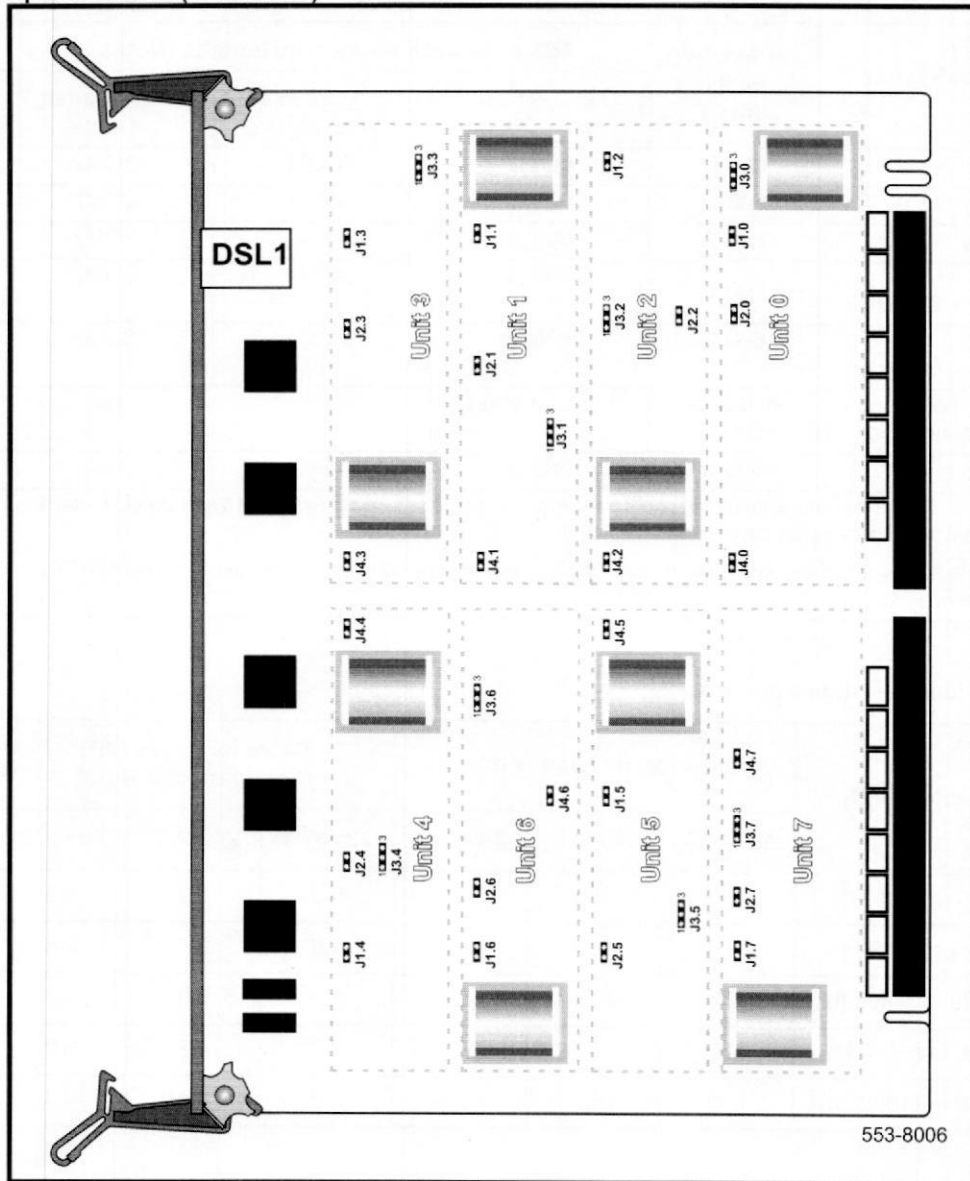


Table 5

Trunk types – termination impedance and balance network (NT5D31AA)

Trunk types	Terminating impedance (Note 1)	Balance network for loop lengths (Note 2)		
		Zero – 762 m (zero – 2500ft)	> 762 m (>2500 ft)	For Loaded Cable
CO/FEX/WATS	600 Ω	600 Ω	3COM	3CM2
2-way TIE (LDR)	600 Ω	600 Ω	3COM	3CM2
2-way TIE (OAID)	600 Ω	600 Ω	3COM	3CM2
DID (loop < 600 Ω)	600 Ω	600 Ω	3COM	3CM2
DID (loop $\geq$ 600 Ω)	600 Ω	600 Ω	3COM	3CM2
RAN: continuous operation mode	600 Ω or 900 Ω	600 Ω or 900 Ω	N/A	N/A
Paging	600 Ω	600 Ω	N/A	N/A

Note 1: The terminating impedance of each trunk unit is software selectable in LD 14 and should match the nominal impedance of the connecting equipment.

Note 2: The balance network of each trunk unit is software selectable between resistive 600 or 900 Ω or 3COM or 3CM2.

Table 6

Cable loop resistance and loss

Cable length	Cable loop resistance (ohms)			Cable loop loss (dB) (non-loaded at 1kHz)		
	22 AWG	24 AWG	26 AWG	22 AWG	24 AWG	26 AWG
915 m (3000 ft)	97	155	251	0.9	1.2	1.5
1524 m (5000 ft)	162	260	417	1.6	2.0	2.5
2225 m (7300 ft)	236	378	609	2.3	3.0	3.7
3566 m (11700 ft)	379	607	977	3.7	4.8	6.0
5639 m (18500 ft)	600	960	1544	5.9	7.6	9.4

Port-to-port loss configuration

The NT5D31AA DXUT provides pad switching for control of end-to-end connection loss. Control of loss is a major element in controlling transmission performance parameters such as received volume, echo, noise, and crosstalk.

The transmission properties of each trunk unit are characterized by the Class of Service (CLS) assigned in the Trunk Administration program (Overlay 14) and the far-end port type (PTYP) in the Trunk Route Administration program (Overlay 16). A complete loss plan is given in *Summary of transmission parameters* where the appropriate port-to-port electrical loss may be determined for connections between any two Meridian 1 ports (lines, analog trunks, or digital trunks).

Electrical specifications

Table 7 gives the electrical characteristics of the DXUT card.

Table 7
Electrical characteristics for the NT5D31AA

Characteristic	CO/FEX/WATS trunks	DID or TIE trunks	RAN trunks	Paging trunks
Terminal impedance	600 Ω or 900 Ω (Note 1)		600 Ω/ 900 Ω (Note 1)	600 Ω
Balance impedance	600 Ω or 900 Ω, 3COM, or 3CM2 (Note 1)		N/A	N/A
Supervision type	Ground or loop start (with BT sup) (Note 2)	Loop start	Continuous, level, or pulse	N/A
DC signaling loop length (max)	1700 Ω loop with near-end battery of -42.75 V	2450 Ω loop with near-end battery of -44 V	600 Ω /900 Ω loop	600 Ω loop
Far-end battery	-42 to -52.5 V (Note 3)	-42 to -52.5 V	-42 to -52 V	N/A
Minimum detected loop current	20 mA	10 mA	10 mA	N/A
Ground potential difference	±3 V		±1 V	±1 V
Low DC loop resistance during outpulsing	<300 Ω	N/A	N/A	N/A
High DC loop resistance	Ground start ≥ 30 KΩ; loop start ≥ 5 MΩ	N/A	N/A	N/A
Ring detection	17 to 33 Hz 40 to 120 V rms	N/A	N/A	N/A
Line leakage	≥ 30 KΩ, tip-to-ring, tip-to-ground, ring-to-ground		N/A	N/A
AC induction rejection	10 V rms, tip-to-ring, tip-to-ground, ring-to-ground		N/A	N/A

Note 1: Selected in software.

Note 2: Loop start with Busy Tone Disconnect Supervision introduced with minimum Release 23 software.

Note 3: For loop extender application, the maximum voltage applied between tip and ring is -105 V ±5%. The minimum DC loop resistance for this type of application is 1800 Ω.

$$V = I \cdot R$$

$$I = \frac{V}{R}$$

$$I = \frac{105V}{1800\Omega} = 58.3 \text{ mA}$$

$$I(<) = \frac{-42V}{300\Omega} = 140 \text{ mA}$$

$$I(>) = \frac{-52.5V}{300\Omega} = 175 \text{ mA}$$

Environmental specifications

Table 8 lists the environmental specifications for the DXUT card.

Table 8
Environmental specifications for the NT5D31AA

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (non-condensing)
Storage temperature	−40° to +70° C (−40° to +158° F)

Foreign and surge voltage protection

The NT5D31AA DXUT card meets UL-1489 and CS03 over-voltage (power cross) specifications and FCC Part 68 requirements.

Operation

The optional applications, features, and signaling arrangements for each unit on the NT5D31AA DXUT card is assigned through the Trunk Administration (Overlay 14), and Trunk Route Administration (Overlay 16) programs and/or jumper strap settings on the cards. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

COT Loop start signaling requires that Busy Tone Detection be configured in software Overlay 97 prior to the configuration of Overlays 16 and 14.

Loop start operation

Loop start operation is configured in software and is implemented in the card through software download messages. When the DXUT card is idle, it provides a high impedance toward the CO for isolation and AC (ringing) detection.

Incoming calls

The CO sends an alerting signal of 20 Hz (nominal) to the Meridian 1 system. Ringing is tripped when this trunk circuit places a low resistance DC loop towards the CO when an attendant is available. Figures 5 and 6 illustrate this process.

Outgoing calls

For outgoing calls from the Meridian 1, software sends an outgoing seizure message to place a low-resistance loop across the tip and ring leads towards the CO (see Figures 7 and 8). When the CO detects the low-resistance loop, it prepares to receive digits. When the CO is ready to receive digits, it returns dial tone. Outward address signaling is then applied from the Meridian 1 in the form of loop (interrupting) dial pulses or DTMF tones.

Polarity-sensitive/-insensitive packs feature

The Meridian 1 software provides the “polarity-sensitive/-insensitive packs” (PSP and PIP) feature for the accurate recording of outgoing call duration for loop start and ground start operation. On trunks equipped with far-end answer supervision, the PSP Class of Service is enabled in software and causes call-duration recording in CDR records to begin only upon receipt of answer supervision from the far end. For trunks not equipped with answer supervision, the PIP Class of Service is enabled and call-duration recording begins immediately upon near-end trunk seizure. The PSP and PIP Classes of Service are enabled in the Trunk Administration program (Overlay 14).

Far end release

If Busy Tone Disconnect Supervision is configured, upon receipt of a busy tone signal from the far end the DXUT trunk will send a busy tone detected message to software. The software will then send a disconnect message to idle the trunk.

Figure 5
Loop start call states – incoming call from CO/FEX/WATS

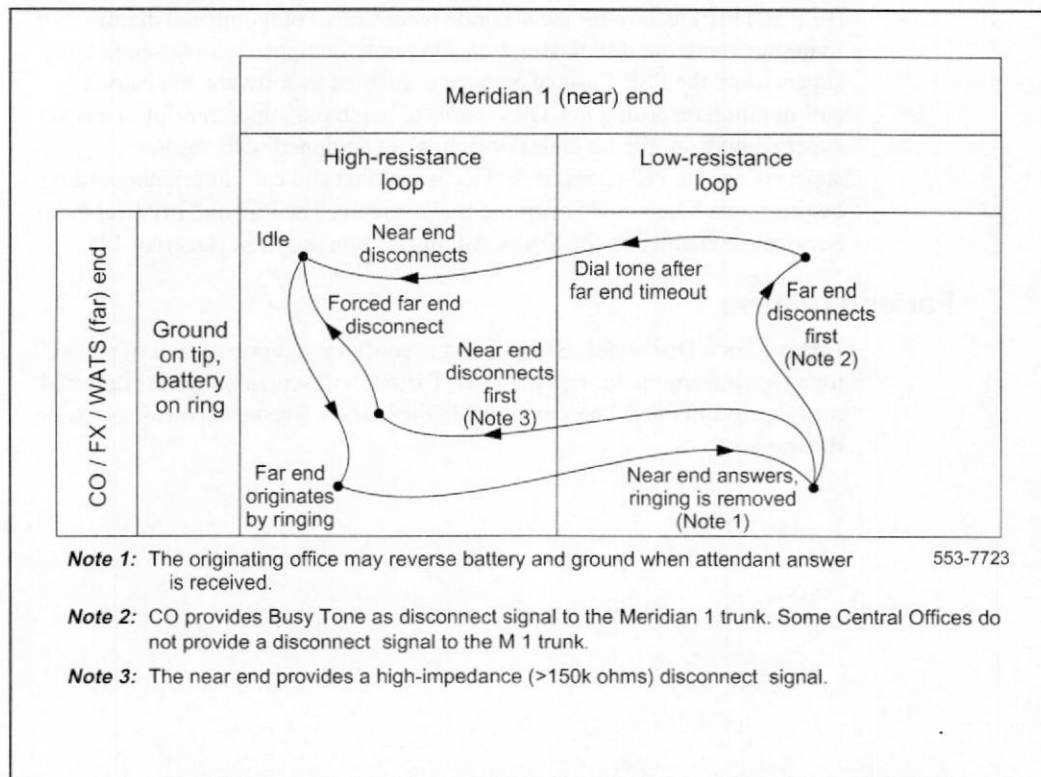


Figure 6
Loop start call connection sequence – incoming call from CO/FEX/WATS

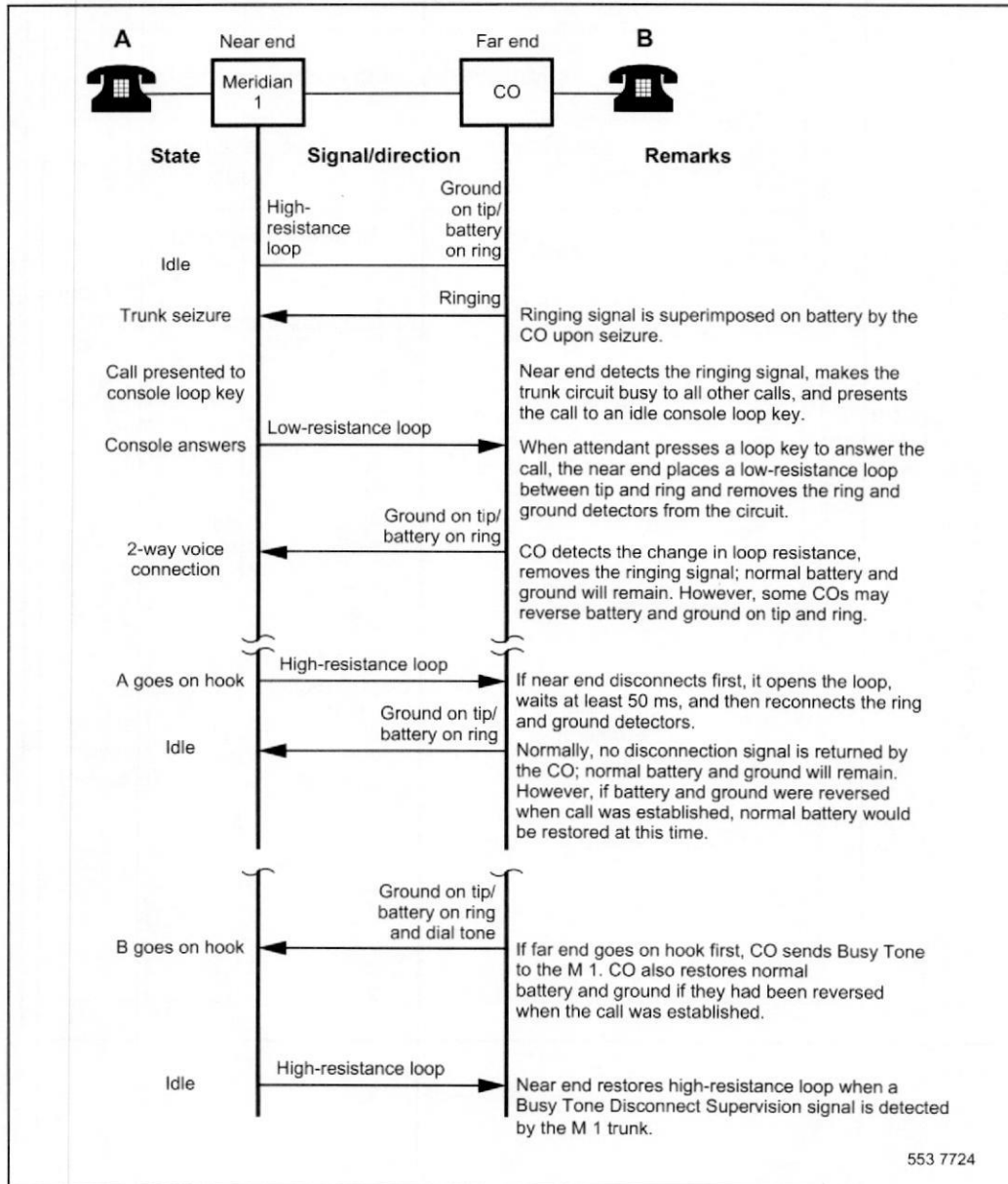


Figure 7
Loop start call states -- outgoing call to CO/FX/WATS

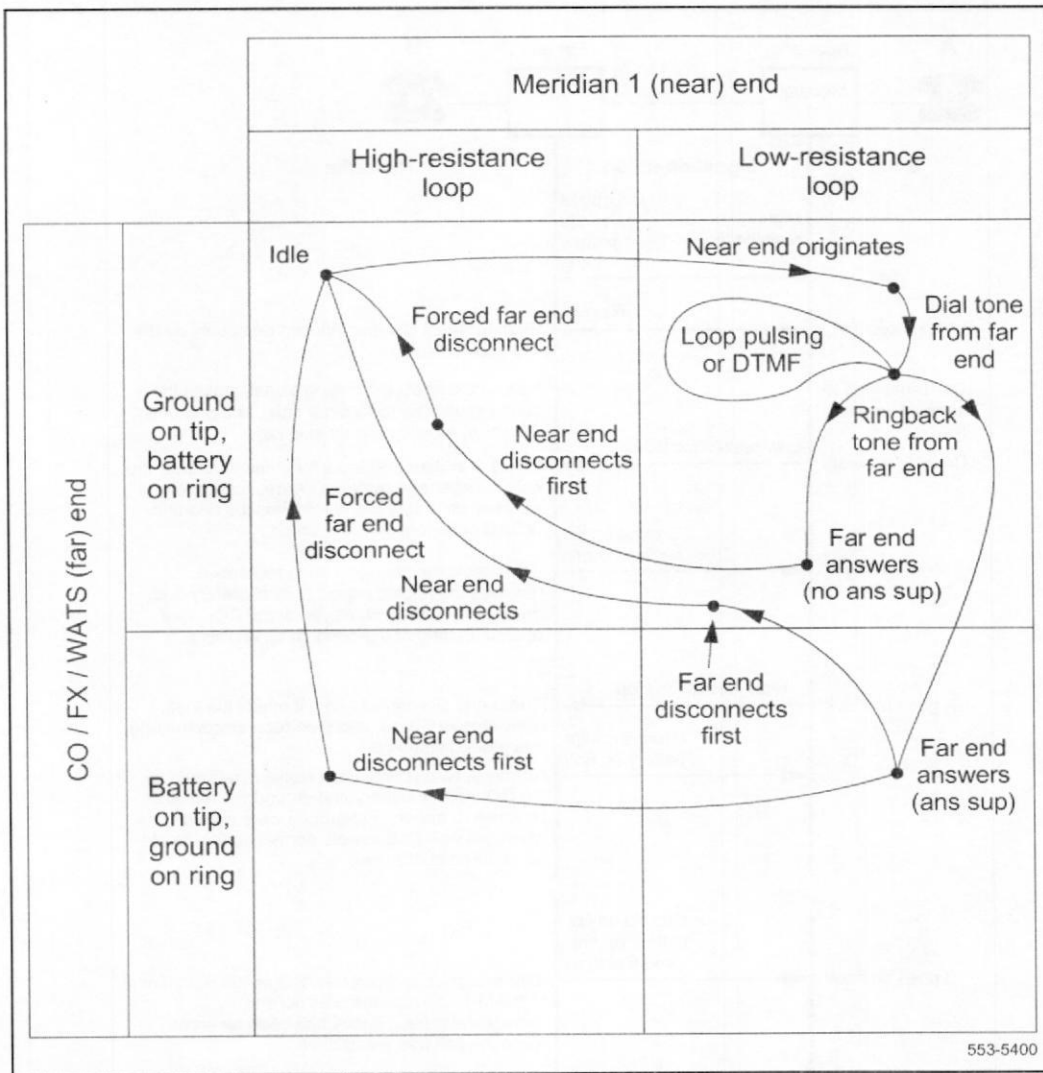
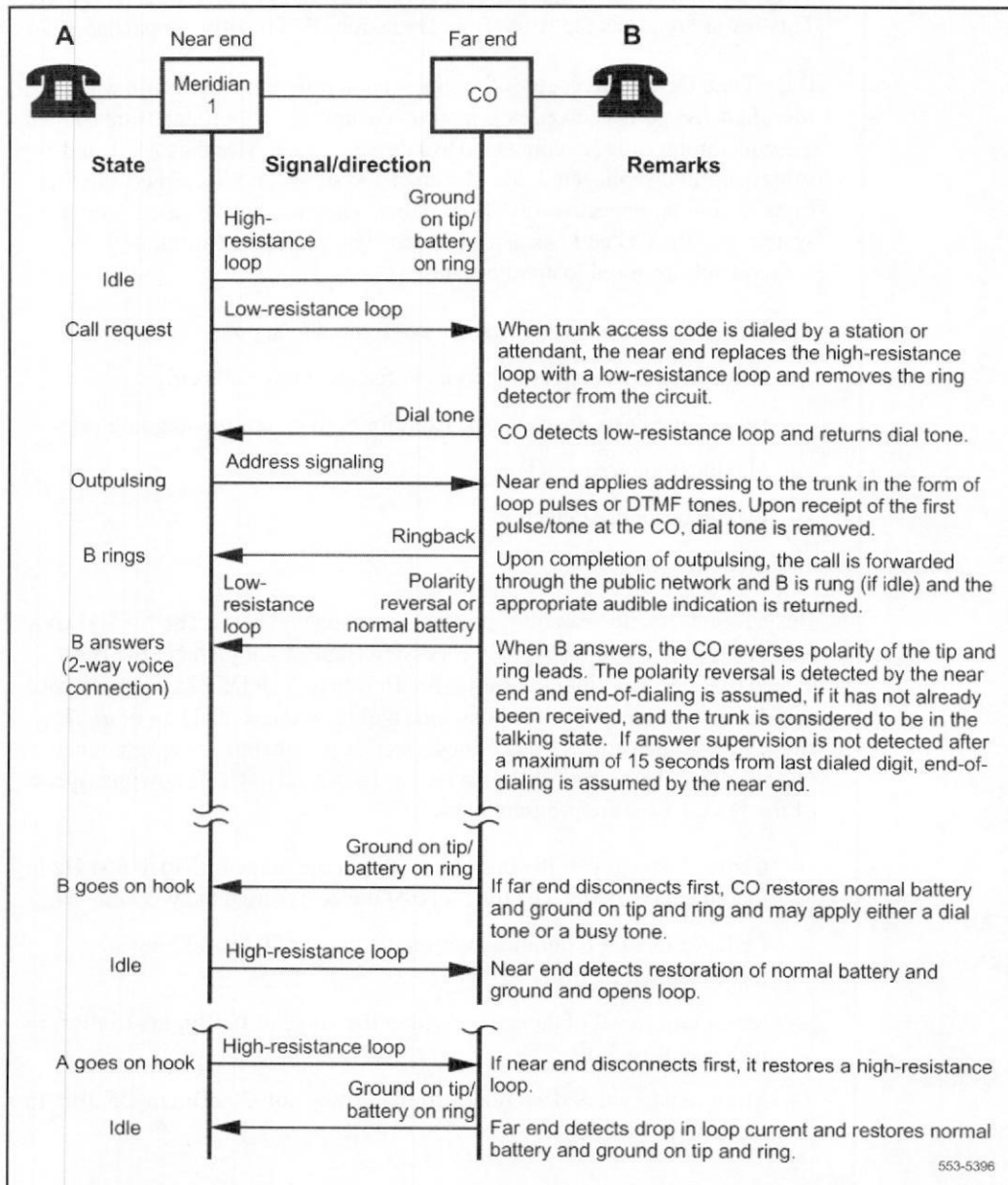


Figure 8
Loop start call connection sequence – outgoing call to CO/FEX/WATS



Busy Tone Detection

The Busy Tone Detection feature is provided by the NT5D31AA DXUT card. This feature requires the Busy Tone Detection (BTD) software package 294.

Busy Tone Detection resolves the supervision problem that occurs when the Meridian 1 system receives calls from an unsupervised loop start trunk. When these incoming calls are connected to a device such as Meridian Mail, and are subsequently disconnected, the Meridian 1 system is not informed and the trunk is held up unnecessarily. Busy Tone Detection notifies the Meridian 1 system that the CO end has disconnected. The Meridian 1 trunk is subsequently restored to an idle state.

The NT5D31AA DXUT card can be configured to support

- Busy Tone Disconnect Supervision for incoming calls only
- Busy Tone Disconnect Supervision for both incoming/outgoing calls
- Flexible tone frequencies
- Flexible cadence detection
- Flexible tone levels

Busy Tone Detection can be applied on a per channel basis. The NT5D31AA DXUT card uses Digital Signal Processing (DSP) to implement the Busy Tone Detection functionality for loop start trunks. The DSP based trunk card can detect a *single* frequency busy tone and busy tones made up of *dual* frequencies. The various Busy Tone Detection parameters are programmed in Overlay 97 and are applicable on a per card basis only. The following aspects of the DXUT card are programmable:

- Center frequency of the busy tone, within the range of 350 to 665 Hz in increments of 5 Hz. The tolerance of the center frequency is ± 25 Hz.
- Cadence ON/OFF duration, within the range of 0 to 1500 ms in increments of 25 ms.
- Maximum Level of detection, within the range of 0 dBm to -15 dBm in increments of 5 dB.
- Minimum Level of detection, within the range of -20 dBm to -35 dBm in increments of 5 dB.

The DXUT card can be plugged into any one of the peripheral card slots in the IPE backplane of a Meridian 1. In the loop start trunk mode, both Reverse Battery and Busy Tone Disconnect Supervision are supported by the card. For Busy Tone Disconnect Supervision, the NT5D31AA card can be configured to support the following options:

- Busy Tone Disconnect Supervision for Incoming Calls only.
- Busy Tone Disconnect Supervision for **both** Incoming/Outgoing Calls.

When busy tone is detected by the DSP tone detector, the tone burst frequency or frequencies (for dual tone), cadences, and level are checked for validity before reporting to the Meridian 1 system CPU through the microcontroller.

International busy tone characteristics for reference

For reference purposes only, the data provided in Table 9 defines the busy tone characteristics of various countries.

The DXUT card is not guaranteed to support Busy Tone Detection in all of the countries listed in Table 9, unless otherwise stated. It is advised that customers consult their local telephone company to confirm their area's busy tone characteristics before putting the DXUT card into service.

Table 9
Busy tone characteristics of different countries (Part 1 of 2)

Country	BT Frequency (Hz)	BT Cadence (ms)	BT Level (dBm)
Mexico	425 +/- 25	250 on/off	-30
Brazil	425 +/- 25	250 on/off	-30
Tortola	480 & 620	250 on/off	-30
Venezuela	450 +/- 10	500 on/off	-10
Chile	400 +/- 10	500 on/off	TBD
Argentina	425 +/- 10	TBD	TBD
Uruguay	425 +/- 10	500 on/off	TBD
Colombia	425	250 on/off	-10
Australia	425 +/- 10	375 on/off	-17
Japan	400 +/- 10	350 on/off	-10/-30
China	450	700 on/off	-10/-30
Malaysia	425	500 on/off	-12
Singapore	425	750 on/off	-10 at CO's MDF
Thailand	400	500 on/off	-5/-15
Indonesia	425 +/- 25	500 on/off	-9 +/- 2.5
Taiwan	480 & 620	250 on/off	-24
Hong Kong	480 & 620	500 on/off	-16 +/- 1 at CO's MDF
Korea	480 & 620	500 on/off & 300 on/200 off	TBD
Philippines	480 & 620	500 on/off	-5 dBm 0
Pakistan	450	250 on/350 off	-10
India	400	750 on/off	-10 +/- 5 dBm 0 at CO's MDF
New Zealand	400	500 on/500 off	TBD
Ireland	425 +/-5	370 on/off	-12.5

Table 9
Busy tone characteristics of different countries (Part 2 of 2)

Country	BT Frequency (Hz)	BT Cadence (ms)	BT Level (dBm)
Germany	435 +/- 55	TBD	-35
Norway	425 +/- 15	250 on/off	-30
Switzerland	425	200 on/off	-16
Holland	445	225 +/- 75 on/off	TBD
Denmark	425 +/- 25	250 +/- 25 on/off	-30 to -5
Italy	425	200 +/- 40 on/off	-30 to -5

Trunk configuration for loop start operation

Busy Tone Detection for loop start signaling is configured in software through Overlay 97, Overlay 16, and Overlay 14.

Busy Tone Detection (BTD) Data Block

Busy Tone Detection is configured in LD 97, as described in Table 10.

Table 10
LD 97 – Busy Tone Detection Data Block

Prompt	Response	Comments
REQ	CHG	Modify existing data
TYPE	BTDD	Busy Tone Detection
BTDD	(0)-7	Busy Tone Detection Table
BCAD	(350) (350)	Busy Tone Cadence (in milliseconds) (ON cycle) (OFF cycle)
	500 500	For Japan
BTDD	(BOTH)	Busy Tone Detection on both incoming and outgoing calls (default)
	INC	Busy Tone Detection on incoming calls only
FREQ_0	350 - 655	Frequency of busy tone for Frequency 0 of a dual Busy Tone Detection to be detected in Hz. Valid entries are in multiples of 5Hz.
FREQ_1	350 - 655	Frequency of busy tone for Frequency 1 of a dual Busy Tone Detection to be detected in Hz. Valid entries are in multiples of 5Hz.
		For a single busy tone FREQ_1 must be set the same as FREQ_0.
FDLT	10 - 315	Frequency Delta. (Currently this feature is NOT in use. Any entry in this field is ignored by the software.) FDLT gives the tolerance of the tone to be detected in +/- hertz. Valid entries are in multiples of 5Hz. For dual Busy Tone Detection on the NT5D31 card, the same frequency delta applies to both tones.

FLVL_MAX	0 - 15	Maximum Frequency Tone level to be detected in dBm. Valid entries are in multiples of 5dBm. For dual Busy Tone Detection on the NT5D31 card, the same level applies to both tones.
FLVL_MIN	20 - 35	Minimum Frequency Tone level to be detected in dBm. Valid entries are in multiples of 5dBm. For dual Busy Tone Detection on the NT5D31 card, the same level applies to both tones.

Route Data Block

Each trunk unit on the NT5D31AA DXUT card is attached to a route with an associated Route Data Block. Trunk timers are configured on a route basis. The Route Data Block is programmed in LD 16, as described in Table 11.

Table 11
LD 16 – Route Data Block

Prompt	Response	Comments
REQ	NEW	Add a new data block to the system
TYPE	RDB	Define a new Route Data Block
CUST	xx	Enter customer number
ROUT	0-511 0-127	Enter route number For Option 11C
TKTP	COT	Define trunk type as Central Office
ICOG	IAO	Incoming and Outgoing trunk
CNTL	YES	Changes to controls or timers
NEDC	ETH	Either end control
FEDC	ETH	Either end control

Trunk Data Block

Use LD 14 to configure each of the trunk units on the NT5D31AA DXUT card, as described in Table 12.

Table 12
LD 14 – Trunk Data Block

Prompt	Response	Comments
REQ	NEW	Define a new trunk unit
TYPE	COT	Central Office Trunk data block
TN	l s c u c u	Terminal number of the unit For Option 11C
XTRK	EXUT	Type is IPE EXUT. This includes the DXUT. (This prompt is required only for the first unit defined on each card.)
SIGL	LOP	Loop Start signaling
TIMP		Termination impedance
	(600) 900	
BIMP		Balance impedance
	(3COM) 600 3CM2 900	
AUTO_BIMP	YES	Auto Balance impedance. (Currently this feature is NOT in use. Any entry in this field is ignored by the DXUT.)
SUPN	YES	Answer and disconnect supervision required
-STYP		Supervision Type
	PIP BTS PIP BTS	Polarity Insensitive Pack Busy Tone Supervision Both options
BTDT	(0)-7	Busy Tone Detection Table (This prompt is required only for the first unit defined on each card.)
CLS	(DIP) DTN	Dial Pulse Digitone